Chemistry Misconceptions

Mulford, D.R.; Robinson, W.R.

\[2 \text{S} + 3 \text{O}_2 \rightarrow 2 \text{SO}_3\]
At end of course, what percent of students will choose most popular wrong answer?

<table>
<thead>
<tr>
<th>Oxygen gas and hydrogen gas</th>
<th>Grad Student Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>43%</td>
<td>8</td>
</tr>
<tr>
<td>40%</td>
<td>10</td>
</tr>
<tr>
<td>35%</td>
<td>17</td>
</tr>
<tr>
<td>25%</td>
<td>41</td>
</tr>
<tr>
<td>10%</td>
<td>25</td>
</tr>
</tbody>
</table>

mint
rose

Mint
Rose
Mint-Rose
Other

smell?
mint
rose

Mint 6%
Rose 4%
Mint-Rose 69%
Other 21%

smell?
What does it mean to understand chemistry?

Research Question and Pedagogical Content Knowledge

• Student can play the chemistry game but not get the chemical ideas. Student ideas are resistant to change.
• Traditional instruction is ineffective.
• Future faculty are unaware of the misconceptions and overestimate the effectiveness of instruction.
• Future pre-college teachers also not so well informed (as many are not chemists).
Laudan ('84), via Duschl ('90), via Abrams & Wandersee ('95)

Triadic model for the growth of SCIENTIFIC EDUCATION knowledge

- Theories ➔ Aims
- Aims ➔ Methods
- Methods ➔ Theories

getting better
Are we really in a paradigm shift?
Students do better with active learning
Freeman, et al. (2014) *Proc National Acad Science*, 111 (23), 8410-8415

Hold up
Blue 7-8
Yellow 5-6
Green 3-4
Red 0-2
Students do better with active learning

Graphs of meta analysis shown from this article, showing that active learning effect is positive across STEM disciplines.
• Had this level of change been encountered in a controlled medical study, the study would have been halted and the placebo group given the treatment.

• What are the ethical implications of ignoring these data?
Diane Bunce (first JCE research editor)

At one of the first meetings of Chemistry Education Research Committee (ACS Division Chemical Education) c.1994 “We need…”

- CER sponsored symposium
- ACS public position regarding scholarship in CER
- Research article “home” in J. Chem. Education
- Publications regarding hiring, P&T, publication in CER
- Faculty hired and tenured in CER or CEP
- Monographs on CER and Chem Ed practices
Where are we going now?
Disciplinary-Based Education Research
UNH CoRE Working Group
Peer-Led Team Learning
How will we continue to move toward better practices?

- DBER: Disciplinary-based Education Research
- Peer-learning
  
  *(What Matters in College? Astin, 1993)*
- Growth mindset for learners and teachers
- Return to “misconceptions”: how do students conceive of STEM ideas
- Move investigations from states to mechanisms: pathways to success, processes for intervention
Thanks for listening.
-- says the mole --